REMARKS/ARGUMENTS

Claims 1, 6 and 12 have been amended without prejudice or disclaimer. Claims 1-16 remain in the application.

Claim Objections:

The Examiner objected to the use of the term "one-step"in claims 1, 6 and 12. Applicants have deleted the term "one-step" and thus request that the objection be withdrawn.

Claim Rejections – 35 USC § 103:

Claims 1-6, 8-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chalmers et al (US 5,272,446).

Independent claims 1, 6 and 12 have been amended to more clearly define the invention. The language "using the single time synchronization word" has been added. Applicants have further amended the claims to include the language "without using an automatic frequency control". No new matter has been added. Support for this amendment is found on page 7, lines 3-10.

The claims, as amended, are believed to overcome the rejection. Prior art techniques require two different processes for frequency acquisition – coarse AFC (Automatic frequency control) and fine frequency estimator as shown and discussed in conjunction with FIGs. 1 and 2, page 2, lines 22-31, page 3, lines 1-2, page 3, lines 21-31, page 4, lines 1-8. The claimed invention achieves fast frequency acquisition by performing only fine frequency estimation before the second CS filter and after frame and symbol synchronization– coarse AFC is not performed. Elimination of the AFC reduces the minimum frequency acquisition time (page 8, line 9-16).

The Examiner rejected all the claims based on Chalmers under 35 USC § 103. Applicants wish first to briefly describe and characterize the Chalmers reference. As disclosed in FIG. 2 and the accompanying text, the Chalmers system employs at least two

different processes for frequency estimation – coarse frequency estimation and fine frequency estimation (Fig 2, 220, 230 and column 8, lines 32-36). Chalmers teaches that the frequency estimator operates on a portion of the received modulated data samples without knowledge of and before frame/burst synchronization (column 7, lines 8-12, Fig 2, 250, column 8, lines 48-52) and symbol time synchronization (column 8, lines 40-47: symbol timing is acquired after match filtering the frequency-corrected samples). The coarse frequency estimator finds the peak of the time-average series of time-hopped windowed DFT/FFTs (column 6, lines 40-65) after the effect of modulation is removed (column 7, lines 1-8), while the fine frequency estimator increases the accuracy of the coarse estimate by performing another DFT/FFT on the coarse frequency estimator DFT/FFT outputs and selecting the maximum bin (column 7, lines 45-59).

Pursuant to Chalmers teachings, the frequency acquisition algorithm is not based on the known sequence of symbols in the Unique/Synchronization word (UW) and the UW is not exploited by the frequency estimator. More particularly, Chalmers does not teach or otherwise suggest that the frequency estimation is performed on only the part of the digital baseband I-Q signal that corresponds to the synchronization/unique word and the knowledge of the known sequence of symbols forming the synchronization/unique word is used for frequency estimation.

In Applicants' invention, on the other hand, and as claimed in amended claims 1, 6 and 12, only the step of fine frequency estimation is performed before the second CS filter, no coarse frequency estimation is performed. Furthermore, the step of fine frequency estimation is performed after frame synchronization detection and coarse symbol time detection (see FIG. 3) using only the part of the digital baseband I-Q signal that corresponds to the synchronization word and the knowledge of the known sequence of symbols forming the synchronization word is used for frequency estimation (support on page 7, lines 3-10). This novel use of only the part of the digital baseband I-Q signal that corresponds to the synchronization word and the known sequence of symbols forming the synchronization word for frequency estimation requires the frame sync detection and symbol time estimation to be performed before frequency estimation (see Fig 3) and results in a more accurate and fast estimate compared to the prior art estimators that do not exploit the known synchronization

word. Applicants have amended each independent claim to more clearly emphasize the fact that the single synchronization word is used for fine frequency estimation.

Additionally, the Chalmers reference teaches that the symbol timing estimator is performed after match filtering the frequency-corrected samples and before burst/frame/slot timing synchronization (column 8, lines 40-52). The symbol synchronization is achieved by computing the phase of the timing error vector obtained by correlating the envelope of the matched filter output with two timing references (column 9, lines 39-50). Thus, the Unique/Synchronization word (UW) is not used for symbol time synchronization which is contrary to what is being claimed by the Applicants in independent claims 1, 6 and 12 wherein the single synchronization word is used to achieve the symbol time synchronization (support on page 7, lines 3-10). Applicants have amended each independent claim to more clearly emphasize the fact that the single synchronization word is used for symbol time estimation.

Furthermore, the Examiner interprets the functionality of the coarse frequency estimator (Fig 2, 220) as equivalent to the claimed coarse symbol time estimator in rejecting step 3 of the claims by stating that time is related to frequency by the relationship t=1/f. Symbol time estimator determines the symbol time synchronization in terms of the location of the boundary between successive symbols or digital data bits (support on page 1, lines 26-31). However, as described above, the Chalmers coarse frequency estimator (FIG. 2, 220) performs coarse acquisition to estimate the carrier frequency offset (column 8, lines 32-36) and is performed before frame/burst synchronization (column 7, lines 8-12, FIG. 2, 250, column 8, lines 48-52) and symbol synchronization (column 8, lines 40-47: symbol timing is acquired after match filtering the frequency-corrected samples). The coarse frequency estimator (FIG. 2, 220) employs a DFT-based technique on a portion of the received modulated data samples without requiring the knowledge of the boundary or the values of the modulated data symbols to estimate the coarse carrier frequency offset. Chalmers states that the effect of modulation is first removed by squaring the complex inputs before coarse frequency estimation (column 7, lines 1-4). The relationship , t=1/f, mentioned by the Examiner gives the period of the estimated coarse carrier frequency offset sinusoid and does not help or provide an indication of the location of the boundary between successive symbols to acquire symbol time synchronization. Applicants contend that Chalmers does not perform

frame synchronization and coarse symbol synchronization before fine frequency estimation and that the coarse frequency estimator (Fig 2, 220) only provides coarse frequency-offset estimation (as is evident from column 8, lines 32-36) and do not provide symbol time estimation capabilities.

Accordingly, the rejection of claims 1, 6 and 12, as amended, is believed to be overcome.

The remaining dependent claims provide further limitation to what are believed to be allowable claims and hence are also in condition for allowance. Applicants also provide the following additional arguments pertaining to dependent claim 3. The Examiner stated that Chalmers discloses sampling 4800 Hz in 1st stage (FIG. 7, fs = 4800 Hz) and sampling 1200 Hz in the 2nd stage (FIG. 2 fs= 1200 Hz), which is a simple fraction to reject claim 3 wherein the second CS filter has exactly half (or any other simple fractions such as one third, or one fourth, etc.) the bandwidth of the first CS filter. Applicants contend that selecting sampling rates that are a simple fraction relationship, does not preclude selecting filters that have bandwidth that do not satisfy the simple fraction relationship. In fact, analysis of Chalmers reveals that the first CS filter has a bandwidth of 5 kHz (see FIG. 2, dual 5kHz LPF) and the second CS filter is an integrate and dump match filter (column 8, lines 40-47, column 9, lines 31-33). See also Examiner's statement with regard to claim 2 of the last Office Action. It is well-known in the art that an integrate and dump match filter has a bandwidth equal to the symbol rate, which for Chalmers system is equal to 1200 Hz. Thus, the bandwidth of the second CS filter (1200 Hz) is not a simple fraction of the bandwidth of the first CS filter (5kHz) although the sampling rates may have such a simple fraction relationship. Hence, the rejection of dependent claim 3 is believed to be overcome.

Accordingly, claims 1, 6 and 12, as amended, are believed to be in condition for allowance. The remaining dependent claims provide further limitation to what are believed to be allowable claims and hence are also in condition for allowance.

The Applicants believe that the subject application, as amended, is in condition for allowance. Such action is earnestly solicited by the Applicants.

The Commissioner is hereby authorized to charge any necessary fee due to Deposit Account No. 50-2117, Motorola, Inc., or credit any overpayment to the same account.

Respectfully submitted,

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